In this activity, students follow steps similar to those in the Where Will They Meet? investigation. TI-Navigator allows students to share their data easily and see equations that classmates try to use to fit the data gathered. The activity contains several Quick Poll questions that help you evaluate student understanding.

Activity Time: 40–50 minutes. The activity time will depend on what data is used: You can gather data with a demonstration in front of the class or each group can collect their own data.

PREREQUISITES AND MATERIALS

Students need to be familiar with stat plots and graphing windows on the graphing calculator, and how to find a line of best fit.

You will need the TI-Navigator activity file **5-1 Systems of Equations.act** and the materials described in the Teacher's Edition.

SETTING UP THE ACTIVITY

On the TI-Navigator teacher computer home screen, click the *Activity Center* icon. Choose **File | Load | Load Activity Settings** and load the activity settings file **5-1 Systems of Equations.act.**

Click the **Graph** tab within the Activity Center.

If you choose to gather data in front of the class, set up the 6-meter course before class starts.

RUNNING THE ACTIVITY

In the Where Will They Meet? investigation, data is gathered for two walkers. You have two options for getting this data to students: Each group of students can perform the activity and gather their own data, or one group can demonstrate the walking in front of the class, and this data can be sent to all students. This activity as written describes how to perform the second option.

1. Ask students to do Step 1 of the investigation in their groups, then discuss the results.
2. Describe the activity scenario to students, and choose one or two students to help you gather data. Use a student's calculator to gather data as described in Steps 2–4 of the investigation. You should have Walker A's data in L3 and L4, and Walker B's data in L1 and L2.

Q1 How should the plots appear if the walkers walked away from the motion sensor at a constant rate? [The plots should show a positive slope or trend.]

Q2 What do the *x*-values represent? [Time in seconds.]

Q3 What do the *y*-values represent? [Distance from the motion sensor in meters.]

For help logging in, see the Tip Sheet.

3. Go to the TI-Navigator home screen and click the **Begin Class** button. Ask students to log in to NavNet. On the TI-Navigator home screen, click the *Collect from Class* icon. In the window that opens, click the arrow next to **LISTS** and select L1, L2, L3, and L4. (Hold the Ctrl key to select multiple lists.) Click **Next.** In the next window, select the student whose data you wish to retrieve (the calculator with which the data was gathered), and check "Force collect from students now." Click **Next.** Select where you wish to store the files, and click **Finish.**

4. Now you'll send this data to all students. Click the *Send to Class* icon. Select the files you just retrieved, and click **Next.** Select all students, check "Force send to students now," and click **Finish.**

5. Students will receive the four lists of data in L1 through L4. Instruct them to press BACK (ZOOM) and select 4: EXIT APP.

For help with Screen Captures, see the Tip Sheet.

6. Instruct students to plot (L3, L4) data for Walker A and (L1, L2) data for Walker B. Graph both scatter plots in the same window. As students work, you may wish to do Screen Captures to evaluate student progress.

Q4 Why do you think the graph has points only in the first quadrant? [Because time and distance must both be positive.]

7. Instruct students to work on Step 5 of the investigation, in which they find an equation that models the data set for each of the two walkers. Be sure that they enter the equations into Y1 and Y2.

8. As students work on investigation Step 5, click the *Activity Center* icon. Choose **File | Load Lists** and select the four lists that you saved in Step 3, then click **Load.** Now configure the plots. To do this, click the **List-Graph** tab. Click Configure Plots and the "Plot Options" window appears. Select L1 for the Plot 1 X-List and L2 for the Plot 1 Y-List. Select L3 for the Plot 2 X-List and L4 for the Plot 2 Y-List.

9. Now reconfigure the activity to receive student equations. To do this, go to **Contribute** and select "Equations" from the pull-down menu. Click the **Configure** button, and the "Configure Calculators for Activity" window will appear. In the **Main Settings** section, choose 2 for "Number of equations per student," and check all three options: "Let students view graphs of equations," "Let students resubmit equations," and "Send current graph contents as

background." In the **Students Start with** section, select "Equations from calculator." Click **OK.** In the Activity Center, click the **Graph-Equation** tab.

10. Instruct students to re-enter NavNet and go to the Activity Center.

11. Click **Start Activity.** Tell students to press SEND (Y=) to send in their lines of best fit.

Q5 What is the real-world meaning of the *y*-intercept? [The distance from the motion sensor at which the walkers started.]

Q6 What is the real-world meaning of the slope? [The rate of change, or the speed, at which the walkers moved away from the motion sensor.]

12. Choose two lines, one for each walker, that you think fit the data well. Hide all the other lines. To do this, you'll highlight all the equations and click **Hide.** Then highlight just the two equations you want to show, and click **Show.**

13. Click **Stop Activity** and reconfigure the activity to contribute points. To do this, go to **Contribute** and select "Points" from the pull-down menu. Click the **Configure** button, and the "Configure Calculators for Activity" window will appear. In the **Main Settings** section, choose 0 for "Number of points per student," enter 0.1 as the "Step size," and check "Display coordinates" and "Send current graph contents as background." Click **OK.**

14. Explain to students that they will have control over a point in the plane and should move their cursor to the intersection point of the two walkers' lines. Click **Start Activity.** Select **View | Individualize Student Cursors.** This will replace the generic cursors with icons that are unique for each student. (If there is a check next to this option, it is already selected.) You may also wish to select **View | Show Student Names.** Then, when you position your mouse over a cursor, you will see the coordinates of the cursor and the Display Name of the student to whom it belongs. Be conscious, though, about allowing students the freedom to explore anonymously. When students have moved to the point of intersection, click **Stop Activity.**

Q7 What is the real-world meaning of the intersection point? [The point where one walker would pass the other, if they were walking at the same time.]

Q8 How can you verify the point of intersection? [Substitute the coordinates for x and y in the equations for both lines, and check that they both result in a true statement.] (*Note:* Demonstrate this.)

Q9 Do a Quick Poll set to "Open Response" and ask "How fast did Walker A walk?" [Answers will vary depending on your line, but it should be about 1 m/s.]

For help with Quick Polls, see the Tip Sheet.

Q10 Do a Quick Poll set to "Open Response" and ask "How fast did Walker B walk?" [Answers will vary depending on your line, but it should be about 0.5 m/s.]

In the next few steps, you'll ask students to consider what happens under different conditions. These questions parallel Steps 9–11 of the investigation.

15. Reconfigure the activity to contribute one equation (as described in Step 9 of this activity). Click **Start Activity.**

Q11 Ask, "Suppose that Walker A walks faster than 1 m/s. How is the graph different? Enter an equation that causes Walker A to go faster and press SEND." [Students' equations should have a steeper slope than before.]

Q12 What happens to the point of intersection? [It moves earlier and closer than before.]

16. Click **Stop Activity.** Choose **Edit | Clear Activity Data.** Click **Start Activity.**

Q13 Ask, "Suppose that Walker A walks at the same speed and in the same direction as Walker B, but from a different starting mark. Enter an equation that matches this situation and press SEND." [Equations should have the same slope as Walker B's line, but a different y-intercept. All answers should be parallel.]

Q14 Ask, "What happens to the intersection point? What does this mean?" [There is no point of intersection. If two people start at different points and walk at the same speed and in the same direction, they will never meet.]

Q15 Do a Quick Poll set to "Open Response" and ask, "Suppose that two people walk at the same speed and in the same direction from the same starting mark. What does this graph look like? How many points satisfy this system of equations?" Have groups consult, and send in only one answer per group.

In this activity sequence, students use TI-Navigator's Activity Center to plot points that satisfy equations and inequalities. This helps them understand that there are many points that satisfy an equation, which lie on a line, and that there are many points that satisfy an inequality, which lie on a half-plane. This activity can be done after or in place of the Graphing Inequalities investigation. The activity concludes with several Quick Poll questions that help to solidify student understanding.

Activity Time: 20–25 minutes

PREREQUISITES AND MATERIALS

You will need one copy per student of the worksheet Graphing Inequalities Grids (found in *Discovering Algebra Teaching and Worksheet Masters*), and the TI-Navigator activity file **5-6 Graphing Inequalities.act.**

SETTING UP THE ACTIVITY

On the TI-Navigator teacher computer home screen, click the *Activity Center* icon. Choose **File | Load | Load Activity Settings** and load the activity settings file **5-6 Graphing Inequalities.act.**

Click the **Graph-Equation** tab within the Activity Center. In the Y= box on the right side of the screen, enter (one at a time) the expressions $1 + 0.5x$, $-1 - 2x$, $1 - 0.5x$, and $1 - 2x$, clicking **Add** after each one is entered. A green line will appear in the Activity Center for each equation. These lines are the lines in the investigation. Now press the Ctrl key on your computer keyboard and select all four expressions (they are now blue), and click **Hide.** Click the **Graph** tab.

RUNNING THE ACTIVITY

For help logging in, see the Tip Sheet.

1. On the TI-Navigator home screen, click the **Begin Class** button. Ask students to log in on their calculators and go to the Activity Center. On the teacher computer, return to the Activity Center and click **Start Activity.** Students will see a graph screen on their calculators. Explain to students that they have control over a point in the plane.

If it is not already selected, select **View | Individualize Student Cursors** to replace generic cursors with a unique icon for each student.

2. Instruct students to move their cursors to coordinates that satisfy the equation $y = 1 + 0.5x$, and request that no two students occupy the same point. When students have formed the line $y = 1 + 0.5x$, click **Pause Activity.** Click the **Graph-Equation** tab, highlight the expression $1 + 0.5x$ on the right side of the screen, and click **Show.** Students should see that the points are all on the line. Click the **Graph** tab again.

3. Instruct students to graph this line, $y = 1 + 0.5x$, on the first grid of the worksheet Graphing Inequalities Grid.

You can position your cursor over a point to display its coordinates. If you would rather not have student names displayed, be sure **View | Show Student Names** is not selected.

4. Now explain to students that they'll move their cursors to coordinates for which the y-values are *less than* the values on the line—that is, (x, y) values for which y is less than $1 + 0.5x$. Click **Resume Activity** and allow to students to start moving. The lower portion of the screen, below the graphed line, should be scattered with points. Click **Pause Activity.** Discuss why particular coordinates plotted satisfy the inequality $y < 1 + 0.5x$.

5. Instruct students to add "$<$" symbols to the first grid of their worksheet, indicating the location of points that satisfy $y < 1 + 0.5x$.

6. Tell students that they'll now move their cursors to coordinates for which the y-values are *greater than* the values on the line—that is, (x, y) values for which $y > 1 + 0.5x$. Click **Resume Activity,** allow students to move, and click **Pause Activity.**

7. Instruct students to add "$>$" symbols to the first grid of their worksheet, indicating the location of points that satisfy $y > 1 + 0.5x$.

8. Repeat Steps 2–7 with the inequalities $y > -1 - 2x$, $y < 1 - 0.5x$, and $y \geq 1 - 2x$. (Hide the equations not currently in use.) When you ask students to graph values that satisfy $y \geq 1 - 2x$, note whether any students move to points *on* the line. If so, point this out. If not, ask whether points on the line satisfy the inequality statement. (*Note:* Navigator cannot graph a dashed line, so you cannot more accurately graph $y < 1 + 0.5x$, as compared to $y \leq 1 + 0.5x$. Discuss the difference between dashed and solid lines with your class.)

For help with Quick Polls, see the Tip Sheet.

Q1 You may wish to conduct a few Quick Polls set to "Yes No," such as the following:

- Does the point $(0, 1)$ satisfy the inequality $y < 1 - 0.5x$? [No.]
- Does the point $(0, 1)$ satisfy the inequality $y \geq 1 - 2x$? [Yes.]
- Does the point $(0, 0)$ satisfy the inequality $y \geq 1 - 2x$? [No. Discuss what this means about the graph—the half of the plane that includes $(0, 0)$ is not shaded.]

In this activity students use TI-Navigator's Activity Center to plot points that satisfy systems of equations and inequalities.

This activity can be done after or in place of the A "Typical" Envelope investigation.

Activity Time: 20 minutes

PREREQUISITES AND MATERIALS

This activity will work best if you have also done the TI-Navigator activity for Lesson 5.6.

You will need one copy per student of the Student Worksheet that accompanies this activity, and the TI-Navigator activity file **5-7 Systems Inequalities.act.**

SETTING UP THE ACTIVITY

On the TI-Navigator teacher computer home screen, click the *Activity Center* icon. Choose **File | Load | Load Activity Settings** and load the activity settings file **5-7 Systems Inequalities.act.**

Click the **Graph-Equation** tab. Enter the expressions (e.g., "$-x - 1$") in the systems below into the Y= box on the right side of the screen, clicking **Add** after each one is entered. Press the Ctrl key on your computer keyboard and select all eight expressions, and click **Hide.** Click the **Graph** tab.

Systems of Inequalities

$y \geq -x - 1$	$y \geq 1/2x - 2$	$y \geq 3x + 1$	$y < x$
$y < 2x + 2$	$y < -4x + 1$	$y < -1/3x + 3$	$y < -2$

RUNNING THE ACTIVITY

In this activity, students move cursors in the Activity Center to first graph the solutions of one inequality, then a second inequality, and finally the region that is the solution to both inequalities simultaneously.

1. Hand out the Student Worksheet that accompanies this activity.
2. On the TI-Navigator home screen, click the **Begin Class** button. Ask students to log in on their calculators and go to the Activity Center. On the teacher computer, return to the Activity Center and click **Start Activity.** Students will see a graph screen on their calculators. Explain to students that they have control over a point in the plane.

For help logging in, see the Tip Sheet.

3. Instruct students to move their cursors to coordinates that satisfy the equation $y = -x - 1$, and request that no two students occupy the same point. When students have formed the line $y = -x - 1$, click **Pause Activity.** Click the **Graph-Equation** tab, highlight the expression $-x - 1$ on the right side of the screen, and click **Show.** Students should see that the points are all on the line. Click the **Graph** tab again.

Q1 Ask one or two students to state their coordinates, and to explain why these coordinates lie on the line. [Students should understand that a point (x, y) satisfies an equation if a true statement results when the x- and y-values are substituted into the equation.]

4. Tell students that next they'll move their cursors to coordinates that satisfy $y \geq -x - 1$. Click **Resume Activity** and wait for students to move their cursors above the graphed line. Click **Pause Activity.** Point out to students which side of the line is "shaded." (They'll use this information again shortly.)

Q2 Again, ask one or two students to state their coordinates, and explain why these coordinates satisfy the inequality. [Students should understand that a point (x, y) satisfies an inequality if a true statement results when the x- and y-values are substituted into the inequality.]

5. Next, instruct students to form the line $y = 2x + 2$ with their cursors. Click **Resume Activity,** wait for students to move, and click **Pause Activity** again. Click the **Graph-Equation** tab, highlight the expression $2x + 2$, and click **Show.** A second green line will appear, which should pass through all the student cursors.

6. Instruct students to move their cursors to coordinates that satisfy $y < 2x + 2$. Click **Resume Activity,** wait for students to move their cursors below the line and click **Pause Activity.** Again, point out which side of the line is "shaded."

7. Now, instruct students to move their cursors to a point that satisfies *both* inequalities, $y \geq -x - 1$ and $y < 2x + 2$. Click **Resume Activity.** When students have moved their cursors to the solution region, click **Pause Activity.** Discuss the results.

Q3 Ask one or two students to state their coordinates, and to explain why these coordinates satisfy the system of inequalities. [Students should understand that a point (x, y) satisfies a system of inequalities if a true statement results when the x- and y-values are substituted into both inequalities.] If no student has positioned their cursor *on* the line $y = -x - 1$, ask whether a point on that line would satisfy the system. [Yes.] Ask whether a point on the line $y = 2x + 2$ would satisfy the system. [No.]

For help with Quick Polls, see the Tip Sheet.

8. Instruct students to graph the two inequalities on their worksheets and shade the area that satisfies the system of inequalities. TI-Navigator cannot draw dashed lines, so be sure to discuss which line in the system should be graphed with a dashed line. Do a Quick Poll set to "Yes No" and ask for each line, "Should this line be graphed dashed?"

9. Repeat Steps 3–8 for the next three systems of equations given on page 46. (Hide unused equations first.) If you like, you can give students additional systems of inequalities and have students graph them on their worksheets without the use of TI-Navigator.

Graph the systems of inequalities given by your teacher on these coordinate axes.